[COMMITTEE PRINT]

THE ENVIRONMENTAL EFFECTS OF DUMPING IN THE OCEANS AND GREAT LAKES

REPORT

PREPARED BY THE

SUBCOMMITTEE ON THE ENVIRONMENT AND THE ATMOSPHERE

OF THE

COMMITTEE ON SCIENCE AND TECHNOLOGY

U.S. HOUSE OF REPRESENTATIVES

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LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, D.C.

Hon. OLIN E. TEAGUE,
Chairman, Committee on Science and Technology,
U.S. House of Representatives.

DEAR MR. CHAIRMAN: I am herewith transmitting the report "Environmental Effects of Dumping in the Oceans and the Great Lakes." This report is based primarily on hearings held before the Subcommittee on the Environment and the Atmosphere, and other supporting material.

The conclusions and recommendations of the report are found in chapter II. The most important finding is the lack of an effective overall management function for ocean dumping research programs in the Federal agencies. We found that ocean dumping research, like other ocean research and environmental research in general, suffers from a "lack of coordination, direction and sense of priority."

As you know, our subcommittee has been and will continue to be very concerned with this state of affairs. Further, we will continue to seek remedies to this situation, especially through the annual authorization process for environmental research, development and demonstration programs in the Federal agencies.

Mr. Chairman, I commend this interesting and useful report to you and the other Members.

Sincerely,

GEORGE E. BROWN, JR.,
Chairman,
Subcommittee on the Environment and the Atmosphere.

CONTENTS

CHAPTER I

INTRODUCTION

Importance of oceans' research

The oceans cover over 70 percent of the Earth's surface and contain some of man's most important resources, including the many varieties of fish which serve as a valuable food resource for millions, and numerous mineral reserves. In addition, the oceans influence our climate and weather through interactions with the atmosphere, provide vital routes for commerce, and are a source of recreation.

While many nations have depended on the oceans' resources throughout history, it may be that numerous traditional fisheries are being overexploited now; moreover, an even greater exploitation of the mineral resources on and beneath the ocean floor may occur in the future. We may soon see the ocean used for floating power plants and new kinds of mariculture. Yet the oceans are blighted with contaminants carried by rivers, falling from the air, and being dumped from barges and ships (the subject of this report). These contaminants are polluting the oceans and causing adverse impacts on fisheries and water quality.

Considering the current strain on ocean fisheries, the present load of contaminants flowing into the oceans, and the ever-increasing exploitation of other ocean resources, it is imperative that we develop an understanding of the effects of these factors have on the oceans. We need much more information on the condition and the dynamics of the oceans, the waters, the bottom sediments, the life forms—and how these interact and change and are affected by toxic materials. At present we do not have this information. At hearings before the Subcommittee on the Environment and the Atmosphere, it was stated that "Scientists disagree about the real effects of many potentially toxic materials on marine life."[1] Thus, additional research is called for. Only with more knowledge about how man's activities affect the ocean can we realistically decide which activities can be safely carried on, which must be modified, and which must be prohibited.

Exactly analogous statements can be made about the Great Lakes which comprise another major international resource threatened by pollution and about which we do not have the necessary knowledge needed to deal with the detrimental activities on a rational basis.

Rationale for the report

Recognizing the importance of ocean and lake research, the Subcommittee on the Environment and the Atmosphere, exercising its jurisdiction over environmental research, held hearings on the Environmental Effects of Dumping in the Oceans and the Great Lakes.

[1] The Environmental Effects of Dumping in the Oceans and Great Lakes. Hearings before the Subcommittee on the Environment and the Atmosphere of the Committee on Science and Technology, U.S. House of Representatives, 94th Cong., No. 55, U.S. GPO, Washington, 1976, p. 119.

It was hoped that the hearings would answer two questions: (1) Do the regulations promulgated under the Marine Protection, Research and Sanctuaries Act reflect the latest research results; and (2) Does the research being carried out adequately support the regulatory policy prescribed by law? This report discusses the Subcommittee's findings in these two areas with the hope of illuminating further Congressional action. It is based largely on information presented at the hearings, but takes into account other reports and documents developed since then. In order to maintain its specific focus, the report does not address in any detail the effects of contaminants reaching the oceans and lakes from rivers, outfalls, runoff, atmospheric fallout, or other non-dumping sources.

The matters under discussion in this report are primarily those concerned with ocean dumping research, which reside within the Committee's jurisdiction. Ocean dumping regulation is not within the Committee's jurisdiction. However, the research being discussed is conducted at least in part to support ocean dumping regulation; thus it was necessary to consider regulatory policy to some extent.

A comprehensive report on regulation of ocean dumping has been prepared for the National Ocean Policy Study by the Congressional Research Service.[2] That excellent report is highly recommended.

Organization of the report

The report is written in five chapters. Following the Chapter I introductory information, chapter II contains findings and recommendations based on the hearings and the information contained in other reports. Chapter III covers the parameters of ocean dumping practice, such as the amount and location of ocean dumping. Chapter IV describes the Federal legislation regulating ocean dumping, the Marine Protection, Research and Sanctuaries Act of 1972 (Public Law 92-532), together with the regulation promulgated under the Act. The hearings are covered only briefly in Chapter V, since they are published in full elsewhere.[3]

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[2] Ocean Dumping Regulation: An Appraisal of Implementation. Committee Print, U.S. Senate, Committee on Commerce and National Ocean Policy Study, U.S. GPO, Washington, D.C., 1976. Hereafter referred to as "Regulation report."

[3] The Environmental Effects of Dumping in the Oceans and Great Lakes. Hearings before the Subcommittee on the Environment and the Atmosphere of the Committee on Science and Technology, U.S. House of Representatives, 94th Cong., No. 55, U.S. GPO, Washington, 1976. Hereafter referred to as the "Hearings."

CHAPTER II

Conclusions and Recommendations

GENERAL

The hearings, other reports, and general interaction with the ocean research community have uncovered the need for varied research to understand the effects of ocean dumping. The Subcommittee review and investigation repeatedly found a lack of coordination, direction, and sense of priority in ocean dumping research. These deficiencies are a miniature of the same but larger problems in overall ocean research and goal identification. The ocean dumping situation serves as a microcosm of the broader ocean situation. There is, to date, no general National Ocean Policy. The Subcommittee recommends the establishment and execution of such a policy, realizing that this recommendation is not original and is much easier to suggest than to implement.

It must be acknowledged that ocean research is not totally an end in itself. While a certain amount of research is obviously pursued for the sake of knowledge, the bulk of Federally sponsored research is in support of various Agency missions. If there is an overall National Ocean Policy guiding agency missions, then this policy would guide the research as well. In other words, the research can be planned and carried out to support the policy. Ocean dumping regulatory and research policy will flow naturally from an overall National Ocean Policy delineation.

At this point it is perhaps worth quoting very briefly from the Regulation Report (pages 74–75) to show that another investigation of ocean dumping research has reached very similar conclusions:

1. *Research Priorities.*—No coherent plan for ocean dumping research exists.

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2. *Coordination.*—No agency has the "lead," or management responsibility, for ensuring that Federal ocean dumping research is coherent, complete, and properly balanced.

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3. *Adequacy of R. & D.*—EPA's ocean dumping research deserves special scrutiny for two reasons. First, since the permit program is based on ocean dumping effects, EPA's competence to assess effects is crucial . . .

The second reason EPA's research program is so important is NOAA's failure to pursue its mandated responsibilities to research alternatives, leaving this to EPA.

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4. *Industrial ocean dumping research.*—The ocean dumping criteria require applicants for ocean dumping permits to provide data on the effects of the proposed dumping and also on potential alternatives. It is not clear, however, that EPA is encouraging industry research to produce useful baseline and effects data as much as possible, because EPA has been putting so much pressure on finding alternatives. Nevertheless, industry led the way in the investigation of

92-732—77—2

ocean incineration possibilities and has also cooperated in various surveys. It seems appropriate to ask if EPA's requirements may be stifling potentially useful research by industries.

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5. *Monitoring.*—Monitoring is critical to ocean dumping regulation because it provides the ultimate check on whether the marine environment is being adversely affected—the basis on which permits are granted. . . .

There are signs of progress in ocean dumping monitoring.

* * * * * * *

6. *Reports.*—For policymakers, information to assess the effectiveness of legislation and the success of its implementation is necessary. To provide some of this information in a timely way, Congress has required EPA and NOAA to report annually on ocean dumping—the former on the regulatory program, the latter on research.

While certainly useful, both reports could be improved.

The first two findings noted lack of priorities and lack of coordination as most important. They indicate that there is no management overview of ocean dumping research. The research is being carried out in several agencies, each having a different primary mission—and none having ocean dumping as a primary concern. For most agencies (with the exception of the Corps of Engineers), ocean dumping research has low priority. The formation of a super-agency, in which all ocean matters would be concentrated, has been proposed—legislation addressing this proposal (S. 3889) was introduced in the 94th Congress by Senator Hollings. Presumably formation of such an agency, itself a major policy decision, would lead to the resolution of many questions and would raise the priority of ocean affairs including ocean dumping issue. However, formation of such an agency would be difficult—major divisions of existing agencies would have to be extracted and reassembled. In addition it is not clear that a super-agency is really required to achieve the overall ocean affairs management that is needed. A relatively small coordinating staff located in the Executive Office of the President, if given the appropriate responsibilities, could achieve this management function. Such a function would be appropriate for the Council on Environmental Quality, the new Office of Science and Technology Policy, or even as a visible and explicit function of the Office of Management and Budget. The staff could be given control over the ocean budgets of the various agencies in a manner similar to the authorization function of a Congressional legislative committee. The staff would need authority to conduct oversight investigations in order to assemble up-to-date information on the adequacy and direction of the oceans programs being carried out in the mission agencies. If such a function were instituted and in operation, there would be a reviewable policy, which could be corrected if necessary. Therefore:

The establishment of an Office of Ocean Affairs in the Executive Office is recommended; with authority (i) to review, coordinate and authorize budgets for ocean-related activities, and (ii) to oversee ocean-related activities in the Federal agencies. It should have an adjunct Oceans Affairs Advisory Council, composed of persons outside the Federal Government which could be adopted from the National Advisory Committee on Ocean and Atmosphere. The Office of Ocean Affairs should make continuing use of interagency task forces for specific planning or evaluation projects.

RESEARCH RECOMMENDATIONS

Specific research needs, as assessed by several authorities in the field, are presented in Chapter V, Hearings. The following four recommendations are more general in nature—their implementation will necessitate specific research projects but detailed project planning is best left to the agencies. It must be emphasized, however, that the recommendations should be carried out through cooperation and coordination between the agencies involved. Finally, it is noted that the four recommendations are not independent—for example, in order to understand the dynamics of changes in ocean ecosystems (first recommendation) one needs the results of baseline studies (the third recommendation).

Better Basic Ocean Understanding

There is an overriding need for a more complete basic understanding of the dynamics of oceans; ocean chemistry, currents, seasonal changes, ocean-atmosphere interactions, biology, water column/bottom interactions, etc. Increased and better coordinated basic research is recommended to provide a framework of understanding into which we can fit the more specific research on effects of ocean dumping. Thus, ocean dumping can be treated as a perturbation of a well-understood dynamic system.

Methods to Measure Effects

There is a need for "yardsticks" or indices of environmental quality against which to measure the impacts of ocean dumping. Methods to predict the impact of ocean dumping in terms of the new "yardsticks" will be necessary. Bioassay tests should be a major part of the new measurement system. Appropriate research to meet these needs is recommended.

Baseline Studies

There is a need for more baseline studies to establish points of reference against which to measure trends and changes. A long-term program of such studies is recommended. These baseline studies should be detailed enough to measure and understand natural fluctuations. The new "yardsticks" described above should be tested and used in the baseline studies. Maximum effectiveness would require that these studies include some clean ocean areas that are projected to remain clean, as well as some areas such as the New York Bight which (it is hoped) will improve in quality.

Basic Processes

There is a need to study how pollutants interact with the environment on a very basic level. For example, how do lead compounds affect organisms at the cellular level? Such research is obviously applicable to many areas other than ocean dumping. In the case of lead, for example, exposure to airborne lead is probably an even greater hazard than lead in the oceans. A basic understanding of such effects will be useful because there are too many pollutants and too many organisms to study all possible interactions. There is, therefore, a need to develop a very fundamental understanding of concepts such as toxicity from which environmental impacts of pollution toxicity can be predicted.

Resources

The research programs recommended will require additional resources, both positions and funds. It is recommended that these additional resources be real increases, that they not be reprogrammed from other ocean research or from other environmental research. The Subcommittee on the Environment and the Atmosphere has repeatedly found that support for environmental research is inadequate to carry out the research mission in support of regulatory programs.[4] Therefore, it would make no sense to increase one environmental research program, specifically ocean dumping research, at the expense of another, and this is not recommended.

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[4] The Environmental Protection Agency's Research Program with primary emphasis on the Community Health and Environmental Surveillance System (CHESS) : An Investigative Report prepared for the Subcommittee on Special Studies, Investigations and Oversight and the Subcommittee on the Environment and Atmosphere of the Committee on Science and Technology. U.S. GPO, Washington, D.C. 1976.

CHAPTER III

Ocean Dumping Practices

AMOUNT AND LOCATION OF OCEAN DUMPING

The primary source for summary information on dumping is the Environmental Protection Agency's (EPA) annual report on ocean dumping.[5] This report does not provide the detail one would need to fully understand the impact of ocean dumping. The tonnage of various wastes dumped is provided, but not the amount of harmful material included in this waste. Specifically, some wastes appear in the form of aqueous solutions such as dilute solutions of sulfuric acid in water. The harmful material is the acid, not the water. Clearly, by dumping a more or less concentrated waste solution, one could change the tonnage dumped without changing the amount of acid introduced into the ocean environment. Nevertheless the figures reported by EPA are instructive since they show where the problems exist.

Dumping of Waste Other than Dredged Material

Table 1 is reproduced from the Fourth EPA Report (page 14). It indicates that ocean dumping is primarily a problem on the Atlantic and Gulf Coasts and is not a problem on the Pacific Coast. (However, significant quantities of sewage sludge are disposed of in the Pacific through ocean outfalls rather than dumping.) According to the table, it appears that ocean dumping is being reduced in the Gulf of Mexico. The table also shows that most of the non-dredged dumping occurs in the Atlantic, and in fact, although not shown in the table, most of this dumping occurs in two restricted areas off the north central coast adjacent to the States of New York and New Jersey. With the exception of a reduction in largely inert Construction and Demolition Debris (which varies considerably, depending on construction activity in New York City), the amount of dumping in the Atlantic seems to have been constant for three years.

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[5] Ocean Dumping in the United States—1976. Fourth Annual Report of the Environmental Protection Agency on Administration of Title I, Marine Protection Research and Sanctuaries Act of 1972, as amended. U.S. EPA, Washington, D.C. 1976. Hereafter referred to as "Fourth EPA Report."

TABLE I.—OCEAN DISPOSAL: TYPES AND AMOUNTS, 1973[1] 1974,[2] AND 1975[3]

[In tons, approximately]

Waste type	Atlantic			Gulf			Pacific			Total		
	1973	1974	1975	1973	1974	1975	1973	1974	1975	1973	1974	1975
Industrial waste	3,642,800	3,642,000	3,322,300	1,408,000	950,000	123,700	0	0	0	5,050,800	4,592,000	3,446,000
Sewage sludge	4,898,900	5,010,000	5,039,600	0	0	0	0	0	0	4,898,900	5,010,000	5,039,600
Subtotal	8,541,700	8,652,000	8,361,900									
Construction and demolition debris	973,700	770,400	395,900	0	0	0	0	0	0	973,700	770,400	395,900
Solid waste	0	0	0	0	0	0	240	200	0	240	200	0
Explosives	0	0	0	0	0	0	0	0	0	0	0	0
Total	9,515,400	9,422,400	8,757,800	1,408,000	950,000	123,700	240	200	0	10,923,640	10,372,600	8,881,500

[1] 1973 source—EPA regional offices. Unpublished reports, 1973; updated information, 1976 (8 mo. of dumping activity, May to December 1973 under permits issued by Ocean disposal program extrapolated for 12 mo to provide an annual rate).

[2] 1974 source—EPA regional offices. Unpublished reports, 1974; updated information, 1976 (12 mo. of dumping activity).

[3] 1975 source—EPA regional offices. Unpublished reports, 1975; updated information, 1976 (12 mo. of dumping activity).

Industrial wastes

The industrial wastes are described variously in the EPA report as:

Miscellaneous lab reagents;
Digester cleanout and chemical wastes;
Chemical wastes;
Refinery wastes;
Byproduct hydrochloric acid;
Titanium dioxide wastes;
Spent caustic and digested biologic sludge;
Sodium-calcium sludge;
Organo-chlorine wastes; and
Spent sulfate solution.

The actual character of wastes can be inferred as acid and caustic wastes, chlorinated hydrocarbons, other hydrocarbons, and solutions of inorganic salts. These wastes would vary widely in their environmental impact, although it would seem unlikely that any would have a beneficial impact.

Sewage sludge

This material results from the treatment of municipal sewage. It contains human wastes, bacteria, heavy metals, pesticide residues, and numerous other components. The sludge is primarily composed of water, and consists of only about 3 to 5% solids. Its density is similar to that of seawater and the dumped material does not simply sink to the bottom (although some heavier particles might) but mixes in the water column. Organic material in the sludge interacts with and therefore removes oxygen dissolved in the water. (This tendency to remove oxygen is referred to as the "oxygen demand" of the material.) Other materials, such as pesticide residues, may also be absorbed or ingested by organisms and thus incorporated into the human food chain.

Dumping of Dredged Material

Under the Marine Protection Research and Sanctuaries Act (Public Law 92–532), the regulation of dredged material dumping is the responsibility of the Corps of Engineers (U.S. Army) and yet the Corps itself dumps the largest volume of this material.

Dumping of dredged material is summarized in Table 2, reproduced from the Fourth EPA Report (page 45). It shows that dredged material is dumped off all coasts in substantial amounts, with the Lower Mississippi Valley Division by far the largest dumper. The amounts are given in cubic yards, not tons, of material dumped. A very approximate conversion factor would be one cubic yard of dredged material being equal to 1.2 tons. Obviously this factor will vary depending on the type of material (gravel, sand, clay, etc.) and the amount of water in the material.

TABLE 2.—DREDGED MATERIAL DUMPED IN OCEAN

[Cubic yards]

Division	Calendar year 1974			Calendar year 1975		
	Corps of Engineers	Permits	Total	Corps of Engineers	Permits	Total
New England	1, 340, 400	921, 800	2, 262, 200	551, 000	331, 500	882, 500
North Atlantic	8, 234, 543	3, 475, 849	11, 710, 392	10, 500, 000	3, 100, 000	13, 600, 000
South Atlantic	2, 931, 748	2, 979, 500	5, 911, 248	11, 360, 250	355, 000	11, 715, 250
Lower Mississippi Valley	54, 600, 000		54, 600, 000	33, 508, 087	12, 000	33, 520, 087
Southwestern	9, 743, 982		9, 743, 982	8, 581, 253	None	8, 581, 253
South Pacific	7, 162, 918	1, 292, 500	8, 455, 418	2, 516, 000	190, 480	2, 706, 480
North Pacific	5, 982, 280		5, 982, 280	7, 473, 792	135, 000	7, 608, 792
Pacific Ocean				30, 000	9, 182, 000	9, 212, 000
Total	89, 995, 871	8, 669, 649	98, 665, 520	74, 520, 382	13, 305, 980	87, 826, 362

Contaminants in dredged material

Some material dredged from polluted harbors can be highly contaminated while other dredged material can be very clean sand and gravel. Describing how dredged material becomes contaminated, Mr. Thomas Glenn, of the Interstate Sanitation Commission testifying before the Subcommittee on the Environment and the Atmosphere stated that over 1,000 tons of sewage solids can be flushed out of combined sewers after a period of rain and of that amount ". . . some settles locally. Some of this is dredged so they pick it up and go dump it again." [6] In 1968 the Corps estimated that an average of 34 percent of dredged material was polluted. This estimate did not consider "heavy metals, chlorinated organics or pathogens" in determining whether or not a material was polluted.[7] The Corps estimate of contamination took into account chlorine, biochemical oxygen demand, chemical oxygen demand, volatile solids, oil and grease, phosphorous, nitrogen, iron, silica, color, and odor to suggest the range of materials one can expect to find in dredged materials. The phosphorous and nitrogen are generally considered nutrients, but if present in large amounts they can cause algae blooms which deplete dissolved oxygen and can result in large fish kills.

RELATIVE IMPORTANCE OF OCEAN DUMPING

The oceans receive contaminants from many sources besides dumping, and these sources should be taken into account so that ocean dumping can be considered in perspective.

Sources of Ocean Contaminants

The 1970 report of the Council on Environmental Quality [8] states that "The amount of wastes transported and dumped in the ocean is small in terms of the total volume of pollutants reaching the oceans." Large amounts of polluting materials are carried to the oceans from rivers and bays. These in turn come from sewage and industrial waste outfalls, runoff, erosion, and miscellaneous sources such as spills and mine drainage. Losses from shipping and commerce are significant and

[6] Hearings, p. 137.
[7] Hearings, p. 36, in footnote 1.
[8] Ocean Dumping: A National Policy. Council on Environmental Quality, U.S. GPO, Washington, 1970. p. iii. Hereafter this report is referred to as the "CEQ report."

may occur anywhere, although they are more likely to occur in or near harbors, straits, and other areas of concentrated marine traffic. Atmospheric fallout is a major source of pollutants such as lead. At the hearings it was stated that:

> In Southern California coastal waters . . . industrial lead input via sewers runs second to inputs of lead from gasoline via storm runoff and dry aerosol deposition (fallout).[9]

Other stresses on the ocean environment may arise from ocean outfalls, energy development, deep seabed mining, and military activities, among others.

On the Pacific Coast deep ocean outfalls deliver sewage sludge directly to the ocean. Combined sewers often discharge to the oceans and contribute to contaminated dredged materials: In New York City, the sewers carry both human wastes and storm drainage. Since the sewers must be large enough to handle heavy storm runoff, normal flow is slow and many solids settle in the mains. When a heavy rain occurs, the settled solids (plus waste from the streets washed into the sewers) are flushed out of the system. The bulk of the sewage bypasses the treatment plant and goes directly to the river or bay, because the treatment plant cannot handle the high storm flows. At the hearings,[10] Mr. Thomas Glenn estimated that "maybe 35 percent of the sewage solids for the whole year are flushed out during a rain and do not get to the treatment plant."

Examples of Various Pollutants

The following is a discussion of some major ocean pollutants in the hope of illuminating the relative importance of various sources of pollution. In most cases the proportion of pollution by various sources is highly uncertain. However, even when ocean dumping is a minor source overall, there may be important localized effects at the dumpsite.

Chlorinated hydrocarbons

Chlorinated hydrocarbons are particularly worrisome substances because they are often toxic, persistent, accumulate in organisms, and concentrate in food chains. The NAS report "Assessing Potential Ocean Pollutants."[11] discusses the hazards of chlorinated hydrocarbons and their sources in the oceans. They conclude that the principal inputs are from rivers, sewers, transportation losses and dumping. Of these sources, it appears that rivers and sewers account for more input to the oceans than dumping. While overall open-ocean concentrations of chlorinated hydrocarbons are far below toxic levels, dumpsite concentrations could be much higher.

Iron

Iron is non-toxic at naturally occurring concentrations and, because it is a nutrient it is "possible that some addition of iron into marine systems could even be beneficial".[12] On the other hand, there have been studies of iron toxicity in fresh water caused by acid mine drain-

[9] Hearings, p. 86.
[10] Hearings, p. 137.
[11] Assessing Potential Ocean Pollutants, Ocean Affairs Board, National Academy of Sciences, Washington, D.C. 1975. Hereafter referred to as "Potential Pollutants."
[12] Potential pollutants, p. 303.

age,[13] so there is some limited evidence that high concentrations can be dangerous.

The report on Potential Pollutants contains a comprehensive discussion of the input of iron to the marine environment. The pertinent conclusions of this discussion are summarized in the following table extracted from that report (p. 322).

TABLE 3.—FLUXES OF IRON TO THE MARINE ENVIRONMENT

[Units of millions of metric tons per year]

Source	Dissolved	Particulate
Natural:		
River runoff	1.4	1,100
Atmospheric fallout	NA	3.2
Total	1.4	1,103.2
Man-induced:		
TiO_2 industry (assumed ocean dumping)	1.0	0
Atmospheric fallout	NA	2.3
Total	1.0	2.3

The table clearly shows that input of iron to the ocean is strongly dominated by particulate river runoff. Dissolved iron would be derived approximately equally from dumping and from natural river runoff, assuming that all the iron wastes from the titanium dioxide industry were ocean dumped.

Copper

This element is more toxic than iron, but like iron, it is also a nutrient at low concentrations. Thus there is a range of copper concentration which is beneficial—too little copper is bad, too much is bad. In addition, different organisms have different tolerances for copper. At the hearings before the Subcommittee on the Environment and the Atmosphere, Dr. Pearce commented on the range of copper concentrations which cause harmful effects in different organisms:[14]

> Some years ago Portmann (1972) described the effects of quite small amounts of copper on a small marine bivalve. He observed that less than 1 PPM of copper severely affected the bivalve *Cardium*. Other investigators have found, however, that similar or greater amounts of heavy metals seem to cause relatively little stress to other species of bivalve molluscs. Bryan (1971) found that certain marine polychaete worms were able to adapt themselves to extreme amounts of copper in the environment in which they live.

The report on potential pollutants analyzed copper much the same way as iron and contained a similar table giving fluxes to the environment.[15] This information is partly reproduced below as Table 4. It shows that even if one assumes that all sewage effluents are dumped, which we know is not true, other sources still account for most of the copper flux to the oceans. Nevertheless, locally high copper concentrations could occur as a result of dumping operations.

[13] Potential pollutants, p. 302.
[14] Hearings, p. 96.
[15] Potential pollutants, p. 334.

TABLE 4.—FLUXES OF COPPER TO MARINE AND FRESHWATERS

[Units of thousands of metric tons per year]

Source	Dissolved	Particulate
Natural:		
River runoff	60	3,300
Atmospheric fallout		5
Man-induced:		
Atmospheric fallout		3
Antifouling boat paints	21	0
Sewage effluents	50	

Pollutants in the New York Bight

The New York Bight, the ocean area between the Long Island and New Jersey shores, is heavily degraded by the influx of contaminants. At the hearings, Dr. Pearce stated: "The New York Bight is perhaps one of the more heavily degraded marine environments in the world."[16] But ocean dumping is not the major contributor to pollution of the Bight. Large amounts of sewage solids bypass the New York metropolitan area treatment plants and flow into the Bight during heavy rains. There are also some 500 million gallons of raw sewage per day entering the Bight from New York City.[17] The large population and industrial concentrations around the Bight contribute great quantities of pollutants. It has been estimated that in the Bight the barging of sewage sludge represents only about 6 to 8 percent of the total concentration of contaminants, and that the balance comes from discharges to rivers and streams, atmospheric fallout, industrial wastes, and runoff from land. In addition, most nutrients in the Bight are believed to come from the Hudson River, and the effects of sewage sludge and dredged material dumping on nutrient concentrations are relatively small and localized.[18]

Short-term vs. long-term effects

Analysis of the above information indicates that ocean dumping should probably be considered in different ways depending on whether one wants to look at short- or long-term effects, or at local or broad scale impacts. Dumping undoubtedly has local, short-term impacts—immediately after dumping contaminant concentrations will be high in the immediate area of the dump. Later, concentrations may or may not remain high depending on currents, mixing, and whether or not the material dumped tends to sink rapidly or remain in suspension. For example, as sewage sludge has a density near that of seawater, it may tend to remain suspended and move with the currents for long periods of time.

Summary

Ocean dumping is a minor but important contributor to contamination of the oceans. It is considered minor because the amounts dumped are small compared to other global sources. However, ocean dumping is important for three main reasons: (1) The materials dumped are often highly noxious chemical wastes (dredged material from polluted harbors, etc.). (2) The concentrations of pollutants at the dumpsites themselves may be high enough to cause severe effects even though the amounts dumped ultimately cause only small concentrations after

[16] Hearings, p. 109.
[17] Hearings, p. 137.
[18] Regulation report, pp. 15, 16.

dilution in the open ocean. (3) Much dumping occurs in ocean areas already severely stressed by other contaminant sources.

The point is that research efforts on ocean dumping should be planned in cognizance of the different scales and different sources of pollutants. Many, but not all, ocean dumping impacts are relatively short-term and local. Long-term and large scale effects should probably take into consideration the impact of other pollutant sources as well as ocean dumping. Thus, an ocean-dumping research program will be most effective if it is not narrowly compartmentalized but is coordinated with other oceans research.

IMPORTANCE OF BRINGING OCEAN DUMPING UNDER CONTROL

Despite regulation under the Marine Protection Research and Sanctuaries Act, ocean dumping will doubtless continue and for some wastes may even increase. In some cases, such as with dredged material, ocean dumping may be the only feasible means of disposal. Factors influencing the continuation of ocean dumping include its direct cost, which is generally competitive with other disposal methods, and the increasing amount of wastes being generated, especially sludges. These sludges will necessarily increase in volume because the Clean Air Act, the Federal Water Pollution Control Act, and related State regulations mandate installation of pollution control equipment which generates sludges. At the hearings, Mr. Ken Kamlet of the National Wildlife Federation emphasized this:

> While air fallout and river input sources of ocean pollution can be expected to decline in response to air and water pollution laws, the pressures will correspondingly increase to ocean-dumping resultant stack scrubber residues and waste treatment sluges.[19]

In effect, the pollutants will be prevented from entering our rivers and atmosphere—instead they are trapped in sludges. As such controls become effective, the input of pollutants to the oceans from rivers and the atmosphere will decrease. Clearly it would not be desirable to have the same pollutants reach the oceans as a result of ocean dumping of sludges. Thus the Marine Protection Research and Sanctuaries Act sets forth the policy that the oceans not be counted as the ultimate "free" dumping ground for waste materials, but that dumping be controlled and permitted only when its effects are acceptable. As has been seen, increases in ocean dumping seem to be leveling off. However, additional research is needed to elucidate effects of dumping in order to issue permits on a rational, informed basis.

Finally, the case of ocean incineration should be discussed. This procedure entails the burning of highly toxic wastes (such as residue from the manufacture of pesticides). This process is carried out on specially equipped ships, far at sea. During the burning, wastes are almost completely destroyed, and since the burning occurs at sea, the incinerator emissions are highly diluted before they reach land. Assuredly, water and air pollution controls will cause the demand for ocean incineration of wastes to increase. According to EPA, ocean incineration is a form of ocean dumping and thus falls within their regulatory jurisdiction. Since the practice of burning is not yet widespread, EPA's regulatory control can have important preventive effects.

[19] Hearings, p. 37.

CHAPTER IV

The Marine Protection, Research, and Sanctuaries Act of 1972, History and Provisions

THE 1970 REPORT OF THE COUNCIL ON ENVIRONMENTAL QUALITY

The publication of the CEQ report, Ocean Dumping, a National Policy, was significant because it was the first high-level report to treat the problem of ocean dumping comprehensively, and led directly to the passage of the Marine Protection Research and Sanctuaries Act of 1972 (Public Law 92–532, hereafter referred to as "The Act"), under which ocean dumping is now regulated.

CEQ Findings

The Council found that there was a critical need for a national policy on ocean dumping, that many ocean-dumped wastes have an adverse impact on the marine environment, and that the volume of ocean dumped wastes was growing rapidly. The CEQ found that in many cases feasible and economic land-based disposal methods were available as alternatives to ocean dumping. In reviewing the then-existing regulatory authorities, the Council found them all inadequate. CEQ's findings also emphasized the international character of ocean dumping.[20]

CEQ policy and regulatory recommendations

The CEQ report made several recommendations most of which have been incorporated into the Act. They are reprinted below, followed by an analysis of the recommendations not embodied in the Act.[21]

The Council on Environmental Quality recommends a comprehensive national policy on ocean dumping of wastes to ban unregulated ocean dumping of all materials and strictly limit ocean disposal of any materials harmful to the marine environment. In order to implement the policy, new regulatory authority is necessary. The Council on Environmental Quality recommends legislation that would:

Require a permit from the Administrator of the Environmental Protection Agency for the transportation or dumping of all materials in the oceans, estuaries, and the Great Lakes.

Authorize the Administrator to ban ocean dumping of specific materials and to designate safe sites.

Establish penalties for violations of regulations.

Provide for enforcement by the Coast Guard.

The Administrator of the Environmental Protection Agency would be guided by the following principles in exerting his authority:

Ocean dumping of materials clearly identified as harmful to the marine environment or man should be stopped.

When existing information on the effects of ocean dumping are inconclusive, yet the best indicators are that the materials could create adverse conditions if dumped, such dumping should be phased out. When further

[20] CEQ report, p. v.
[21] CEQ report, p. v, ff.

information conclusively proves that such dumping does not damage the environment, including cumulative and long-term damage, ocean dumping could be conducted under regulation.

The criteria for setting standards for disposing of materials in the ocean and for determining the urgency of terminating disposal operations should include:

1. Present and future impact on the marine environment, human health, welfare, and amenities.
2. Irreversibility of the impact of dumping.
3. Volume and concentration of materials involved.
4. Location of disposal, i.e., depth and potential impact of one location relative to others.

High priority should be given to protecting those portions of the marine environment which are biologically most active, namely the estuaries and the shallow, nearshore areas in which many marine organisms breed or spawn. These biologically critical areas should be delimited and protected.

The Council on Environmental Quality recommends the following policies relating to specific types of wastes currently being dumped in the ocean, in estuaries, and in the Great Lakes:

Ocean dumping of undigested sewage sludge should be stopped as soon as possible and no new sources allowed.

Ocean dumping of digested or other stabilized sludge should be phased out and no new sources allowed. In cases in which substantial facilities and/or significant commitments exist, continued ocean dumping may be necessary until alternatives can be developed and implemented. But continued dumping should be considered an interim measure.

Ocean dumping of existing sources of solid waste should be stopped as soon as possible. No new sources should be allowed, i.e., no dumping by any municipality that currently does not do so, nor any increase in the volume by existing municipalities.

Ocean dumping of polluted dredge spoils should be phased out as soon as alternatives can be employed. In the interim, dumping should minimize ecological damage. The current policy of the Corps of Engineers on dredging highly polluted areas only when absolutely necessary should be continued, and even then, navigational benefits should be weighed carefully against damages.

The current policy of prohibiting ocean dumping of high-level radioactive wastes should be continued. Low-level liquid discharges to the ocean from vessels and land-based nuclear facilities are, and should continue to be, controlled by Federal regulations and international standards. The adequacy of such standards should be continually reviewed. Ocean dumping of other radioactive wastes should be prohibited. In a very few cases, there may be no alternative offering less harm to man or the environment. In these cases ocean disposal should be allowed only when the lack of alternatives has been demonstrated. Planning of activities which will result in production of radioactive wastes should include provisions to avoid ocean disposal.

No ocean dumping of chemical warfare materials should be permitted. Biological warfare materials have not been disposed of at sea and should not be in the future. Ocean disposal of explosive munitions should be terminated as soon as possible.

Ocean dumping of industrial wastes should be stopped as soon as possible. Ocean dumping of toxic industrial wastes should be terminateed immediately, except in those cases in which no alternative offers less harm to man or the environment.

Ocean dumping of unpolluted dredge spoils, construction and demolition debris, and similar wastes which are inert and nontoxic should be regulated to prevent damage to estuarine and coastal areas.

Use of waste materials to rehabilitate or enhance the marine environment, as opposed to activities primarily aimed at waste disposal, should be conducted under controlled conditions. Such operations should be regulated, requiring proof by the applicant of no adverse effects on the marine environment, human health, safety, warfare, and amenities.

Incorporation of CEQ recommendations in the act

In most cases, the Marine Protection Research and Sanctuaries Act of 1972 incorporated the CEQ recommendations. Where it did not, it usually provided general authority under which the EPA has been promulgating regulations. The actual regulatory policy followed by the EPA has been for the most part very consistent with the CEQ report. There are, however, at least three areas where neither the Act nor promulgated regulations explicity follow the recommendations: (1) The CEQ recommended that high priority be given to protection of areas with highest biological activity and productivity—EPA has not given this area high priority. (2) The CEQ recommended that dumping of undigested sewage sludge be phased out—EPA does not give extra attention to undigested sludge. (3) The CEQ recommended that dumping of polluted dredge material be phased out, but there is no explicit regulatory provision for such a phase-out.

Research needs

The CEQ report found that implementation of the policy recommendations would require a great deal of information related to the effects of dumping on the ocean environment. These information needs in turn defined necessary programs of research. The following recommendations are taken from the CEQ report.[22]

> Broad based ecological research is needed to understand the pathways of waste materials in marine ecosystems. Such studies should be directed to a better understanding of the food chain from microscopic plants and animals to high predators; how pollutants concentrate in the food chain; the origin and ultimate fate of pollutants in the oceans; and the effects of concentration on the marine environment and eventually man.
>
> Marine research preserves should be established to protect representative marine ecosystems for research and to serve as ecological reference points—baselines by which man-induced changes may be evaluated.
>
> Oceanographic studies of basic physical and chemical processes should be directed toward gaining a thorough understanding of the marine environment, with special emphasis on estuaries and coastal areas.
>
> Toxic materials should be identified and their lethal, sublethal and chronic long-term effects on marine life investigated. Information is needed on the persistence of toxic substances; how pollutants are degraded chemically and biologically; the effects of radioactivity on the marine environment and man; and the capacity of waters to assimilate waste materials.
>
> More information is needed about public health risks from ocean pollution. Studies should determine what pathogens are transported in marine ecosystems and how. Better methods of measuring public health dangers are also needed.
>
> Research is needed on the recycling of wastes and the development of alternatives to ocean dumping. Technical problems must be solved, but there is also a great need to study the social, institutional, and economic aspects of waste management.
>
> Effective national and international monitoring systems need to be developed. Research is necessary to develop improved methods and technology so that alterations in the marine environment may be detected. But there is also a need for data coordination so that data gathering and analysis efforts are not duplicated.

It is noteworthy that essentially the same research needs exist today.[22a] Thus much of the research program laid out in 1970 is still not accomplished. (Discussion of Corps of Engineers work dealing with dredged materials appears later.)

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[22] CEQ report, p. vii.

[22a] At the hearings (p. 96), Dr. Pearce stated, for example, that "In spite of the voluminous literature which is being developed in regard to the toxicity of various industrial and domestic wastes, and the individual constituents of the waste, it is still extremely difficult to predict effects of any one toxin or contaminant on a particular marine organism."

THE MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT

The Act was passed on October 23, 1972 and became effective six months later. Amendments were made in 1974 which, though small, were important because they brought the Act into accord with the 1972 International Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. Both the Act and the Convention are described fully in a review of Federal environmental law.[23] The regulations promulgated under the Act are described and explained in the report on Ocean Dumping Regulation prepared by the Senate National Ocean Policy Study.[2] The interested reader is referred to the above mentioned documents for a more complete description of the Act, regulations promulgated under it, and the implementation of these regulations. As this report is focused on research related to dumping, the regulatory aspects are described only to illuminate the regulatory policy goals which must be supported by research. Similarly as the Convention and the Act are in accord, no special research programs are called for by the Convention. The United States is involved in no significant international research projects specifically related to ocean dumping.

Provisions of the Act

Title I

The following paragraphs describe the regulatory provisions of the Act and are taken from the Regulation Report (pp. 4–6.[2] MPRSA refers to the Act and FWPCA refers to the Federal Water Pollution Control Act Amendments of 1972.

The MPRSA, enacted 5 days after the Federal Water Pollution Control Act Amendments, adopts a policy of regulating the dumping of all types of materials into ocean waters[24] and preventing or strictly limiting the dumping of materials which would "adversely affect human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities."[25] Whereas the FWPCA prohibits (except under permit) the discharge of pollutants into ocean waters from land-based outfall structures, the MPRSA regulates the dumping of waste materials (other than oil) into ocean waters from vessels or other floating craft.

The MPRSA, commonly referred to as the "Ocean Dumping Act," is divided into three titles: Title I—Ocean Dumping; title II—Comprehensive Research on Ocean Dumping; and title III—Marine Sanctuaries.

Title I of the Ocean Dumping Act is the primary regulatory mechanism of the act, with provisions for EPA permits for ocean dumping of nondredged waste materials, corps permits for dumping of dredged materials, and penalties for violations of permit conditions.

Specifically under title I, all ocean dumping is prohibited except when authorized by permit. Permits for dumping of materials (other than dredged materials) can be issued by the EPA (after notice and opportunity for public

[23] Federal Environmental Law, Dolgin and Guilbert, eds., pp. 649–671, Environmental Law Institute, West Publishing Co., St. Paul, 1974. Hereafter referred to as Federal Environmental Law.

[24] "Oceans" are defined in the act as all waters beyond the "baseline" of the coast and thus include the territorial seas, the contiguous zone, and the oceans themselves. Including the territorial seas constitutes an overlap with certain provisions of the Federal Water Pollution Control Act Amendments of 1972, an overlap which is dealt with by a provision in this title which supersedes that segment of the Federal Water Pollution Control Act, and by the fact the same set of criteria have been used to satisfy the requirements of both acts.

[25] Sec. 2(b) of Public Law 92–532.

hearings), while permits for dredged material will be issued by the Corps (after notice and opportunity for public hearings). No permits may be granted for dumping any radiological, chemical, or biological warfare agent or any high-level radioactive waste. Permits for all other materials may be granted only upon determination that "such dumping will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities."[26] The question of when dumping causes unreasonable degradation is open to some question. Whereas the FWPCA prohibits dumping in cases of uncertainty, the MPRSA leaves this as a judgment question for EPA and the corps.

In reviewing and evaluating permit applications for nondredged materials, the EPA Administrator shall establish and apply certain criteria. In establishing and reviewing the criteria, he is required to consider the following:[27]

(A) The need for the proposed dumping;

(B) The effect of such dumping on human health and welfare, including economic, esthetic, and recreational values;

(C) The effect of such dumping on fisheries resources, plankton, fish, shellfish, wildlife, shore lines and beaches;

(D) The effect of such dumping on marine ecosystems, particularly with respect to:

(i) The transfer, concentration, and dispersion of such material and its byproducts through biological, physical, and chemical processes;

(ii) Potential changes in marine ecosystem diversity, productivity, and stability; and

(iii) Species and community population dynamics.

(E) The persistence and permanence of the effects of the dumping;

(F) The effect of dumping particular volumes and concentrations of such materials;

(G) Appropriate locations and methods of disposal or recycling, including land-based alternatives and the probable impact of requiring use of such alternate locations or methods upon considerations affecting the public interest;

(H) The effect on alternate uses of oceans such as scientific study, fishing, and other living resource exploitation, and non-living resource exploitation;

(I) In designating recommended sites, the Administrator shall utilize whenever feasible locations beyond the edge of the Continental Shelf.

Criteria pursuant to this section of the Ocean Dumping Act were published on October 15, 1973 in the Federal Register.[28] These are the same criteria which satisfy the requirement under section 403 of the FWPCA.

The Secretary of the Army, in reviewing and evaluating permits for dumping dredged material, is required to consider the aforementioned EPA criteria relating to the effects of the dumping. In addition, the Secretary is required to make an independent determination as to the need for the dumping based upon an evaluation of the potential effect of a permit denial on navigation, economic and industrial development, and foreign and domestic commerce of the United States.[29] Furthermore, the Secretary must examine other possible methods of disposal and appropriate locations for dumping.

The Secretary of the Army is required to notify the Administrator of the EPA prior to issuing a permit. The Administrator may deny issuance of the permit if he determines that the permit is not in compliance with the EPA criteria. The Administrator may grant a waiver, however, to the Secertary of the Army, if the Secretary determines that there is no economically feasible method or site available for dumping dredged material other than the site which would result in noncompliance with the criteria.[30]

For Federal projects involving dredging, regulations have been published by the Corps prescribing the policies, practices, and procedures to be followed in the review of Federal projects performed by the Corps of Engineers which involve the disposal of dredged material in navigable waters or the transportation of dredged material for the purpose of dumping it in ocean waters. These regulations, developed pursuant to sections 313 and 404 of the FWPCA and section 103(c) of the MPRSA, were published in the Federal Register on July 22, 1974. The Corps has the responsibility of following these regulations in disposing of the spoils from its own dredging projects, but it is not required to have a permit.

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[26] Sec. 2(b) of Public Law 92-532.
[27] Sec. 102(a) of Public Law 92-532.
[28] Federal Register, vol. 38, 198, Oct. 15, 1973, pp. 28610-28621.
[29] Sec. 103(h) of Public Law 92-532.
[30] Sec. 103(d) of Public Law 92-532.

For the purposes of Title I, $4,800,000 are authorized to be appropriated for fiscal year 1977.

Title II

This title instructs the Secretary of Commerce to conduct a broad program of research related to ocean dumping.

Section 201 provides that the Secretary, in coordination with the Coast Guard and EPA, shall conduct a "comprehensive and continuing program of monitoring and research on the effects of dumping" into the oceans and the Great Lakes. There is also provision for an annual report by the Secretary.

Section 202 provides that the Secretary of Commerce shall initiate a continuing program of research "with respect to the possible long range effects of pollution, overfishing, and man-induced changes of ocean ecosystems". The Secretary shall consider international policies, economic considerations, alternatives to existing programs, and ways to best preserve the health of the oceans. An annual report is required and the Secretary is authorized to cooperate with other Federal agencies and other nations in carrying out the provisions of the section.

Section 203 provides that the Secretary shall conduct, and assist other authorities in the conduct of, a program of research "for the purpose of determining means of minimizing or ending all dumping of materials within five years. . . ."

The Secretary of Commerce has delegated his responsibilities under the Act to the National Oceanic and Atmospheric Administration (NOAA).

There are authorized to be appropriated $5,600,000 for purposes of Title II for fiscal year 1977.

Title III

This title provides for the establishment of Marine Sanctuaries and does not concern us here.

Research Required Under the Act

The following table presents, in summary form, the research required to carry out the provisions of the Act. It can be seen that a broad and continuing research program will be needed.

TABLE 5: SUMMARY OF RESEARCH REQUIREMENTS UNDER THE MPRSA

TITLE I: RESEARCH IN SUPPORT OF REGULATIONS

SEC. 102. Administrator of EPA is to conduct research that will enable him to make the required determination that dumping of non-dredged material "will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment ecological systems or economic potentialities." In making this finding the Administrator must consider and therefore conduct research on the following:

(A) Need for dumping;
(B) Effects on human health and welfare;
(C) Effects on fisheries, resources, etc.;
(D) Effects on marine ecosystems;
(E) Persistence of effects;
(F) Effects of dumping particular materials;
(G) Use of alternate methods and locations for disposal;
(H) Effects of dumping on alternate uses of the oceans; and
(I) Dumping beyond the edge of the Continental Shelf.

Administrator of EPA must also determine that dumping will not violate applicable water quality standards.

Administrator of EPA, based on criteria above, may designate dumpsites, or critical areas where no dumping may occur. In either case, research may be required.

SEC. 103. With respect to dumping of dredged-material, the Secretary of the Army must make similar determinations, of environmental impact, etc., and may conduct research to enable him to make such determinations. The Secretary will also make an independent evaluation of the need for dumping.

SEC. 104. Administrator of EPA may conduct research to determine what dumping has minimal impact and thus qualifies for a general permit.

He may conduct research to gather information needed for the review and revision of permits.

He may require that information be submitted by applicants for permits, thus requiring the applicants to conduct research.

TITLE II: SPECIFICALLY AUTHORIZED RESEARCH

SEC. 201. The Secretary of Commerce shall conduct a "comprehensive and continuing program of monitoring and research regarding the effects of dumping."

SEC. 202. The Secretary of Commerce shall conduct a "comprehensive and continuing program of research . . . (on) long-range effects of pollution, overfishing, and man-induced changes of ocean ecosystems."

SEC. 203. The Secretary of Commerce shall conduct research on "means of minimizing or ending all dumping.", specifically, research on alternatives to dumping.

REGULATION OF DUMPING UNDER THE ACT [31]

Regulations [32] provide for a system of permits, issued according to specified criteria. The following sections describe the regulatory system and the permits issued under this system for non-dredged and dredged materials.

Regulations and Criteria for Nondredged Materials

Classes of nondredged materials

The regulations establish four classes of materials, based on their potential for environmental harm.

"Absolutely prohibited" materials will not be approved for dumping under any circumstances. These include: (i) High-level radioactive wastes; (ii) Materials for radiological, biological, or chemical warfare; (iii) Materials insufficiently described to allow for determination of their environmental impact; (iv) Materials that will float or remain in suspension.

"Prohibited in excess of trace contaminants"—this second class of materials may not be present in such wastes as sewage sludge or dredged materials in larger than "trace" amounts. The class includes: halogenated organics; mercury and its compounds; and oils, and greases taken aboard a vessel for purposes of dumping. Unfortunately, "trace" levels are not defined in numerical terms for wastes (such as sewage sludge) from facilities that are not involved in the manufacture of the material. For example, since a sewage treatment plant does not manufacture cadmium compounds, what might be a "trace" amount of cadmium in its sludge is not defined. Specific numerical limits are provided in the regulations for wastes from plants manufacturing the materials.

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[31] For a fuller discussion, see Regulation Report, pp. 8–13, from which most of this section is taken.

[32] Ocean Dumping Regulations; 40 CFR parts 220 through 227.

The third class of materials is termed "strictly regulated". This class includes large quantities of acids or alkalis, containerized wastes, living organisms which might infect an area, certain metals, and biocides. These materials may be dumped if it can be determined that there will be no adverse environmental impact once they have been diluted by mixing with the ocean.

The fourth and final classification is known as "less strictly regulated". This refers to materials that are non-toxic and or generally insoluble and which will have a negligible environmental effect.

Permits for nondredged substances

EPA's regulations provide for five types of permits for ocean dumping.

"General" permits are issued for the dumping of small amounts of non-toxic materials. There were no general permits in effect in 1974 or 1975.[33]

"Special" permits have a fixed expiration date and are issued for materials such as "blasted tunnel rocks" and "cellar dirt construction rubble".[34] In 1974 there were nine special permits in force and in 1975 [33] there were two.

"Emergency" permits are granted by the Administrator of EPA for the dumping of materials otherwise prohibited and where there is a demonstrated emergency, presenting a risk to human health and having no other feasible solution. Emergency permits have been granted for such things as disposal of wrecks. In both 1974 and 1975 [33] there were two emergency permits in force.

"Interim" permits are issued by the Administrator for the dumping of materials which do not meet the ocean dumping criteria but which must be dumped because there is no other feasible alternative. These permits are issued only under the following conditions:

(*i*) The environmental impact of the dumping has been assessed, the need for the dumping has been examined and alternatives to ocean dumping have been explored.

(*ii*) The dumper must develop and implement a plan either to end the dumping or to modify the material or dumping practice to bring it into compliance with EPA-established criteria.

These permits are valid for a maximum of one year and may be renewed if the dumper shows satisfactory progress toward implementing the plan mentioned above. In 1974 there were 85 interim permits in force and in 1975 [33] there were 29.

"Research" permits may be granted if the Administrator determines that the scientific merit of the project outweights the potential environmental damage caused by the project. In 1974 there were two research permits in force and in 1975 there were none.[33] Both of the research permits issued were for tests of ocean incineration of particularly noxious wastes.

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[33] Fourth EPA report, pp. 7–9.
[34] Regulation report, p. 11.

Table 6 summarizes the permits in force for 1975 by EPA region.

TABLE 6.—EPA DUMPING PERMITS IN FORCE IN 1975

Region	Number	Type	Material
I (New England)	1	Special	Miscellaneous lab reagents.
II (New York)	14	Interim	Sewage sludge.
	8	do	Industrial wastes.
	1	Special	Construction rubble.
III (Philadelphia)	2	Interim	Sewage sludge.
	1	do	Industrial wastes.
VI (Gulf)	3	do	Do.
IX (California)	1	Emergency	Ship.
Headquarters	1	Interim	Industrial wastes.
	1	Emergency	Barge.

Enforcement Activities [35]

In 1975 the Coast Guard conducted 591 disposal surveillance missions and 70 vessel boardings. Eight violations were detected: One involved dumping without a permit, the others involved violation of the physical permit conditions. None involved examination to determine that the waste being dumped was the particular waste specified in the permit. In these eight cases, six fines were imposed and paid, two penalties are pending at this writing. In addition, EPA itself has issued notices of violation in six of the cases in which either fines have been paid or in which the cases are still pending.

Phasing-out of nondredged material dumping [36]

The record shows that EPA is becoming more restrictive with dumpers. Since the permit system went into effect 81 ocean dumping permit applications or renewals were either not granted or not reissued. Seventy six of these were on the Atlantic Coast. Ten current dumpers are scheduled to cease ocean dumping by 1976 and eight more by 1977. Only eleven disposal sites were in active use in 1975: One in Massachusetts Bay, six in the Atlantic Bight (south of Long Island, north of the mouth of the Chesapeake), three in the Gulf of Mexico, and one off Puerto Rico.

Regulation of Dredged Material

The Corps of Engineers is given responsibility under the Act for regulating the disposal of dredged materials. The Corps is also by far the largest contributor of dredged materials, generated by its program of harbor and channel maintenance. Thus a potential conflict of interest exists here. Through its Dredged Material Research Program, the Corps has undertaken a substantial research effort to understand and mitigate the adverse effects of dredging and spoil disposal.

Regulations published by the Corps [37] divide dredged material into polluted and unpolluted classes.

Unpolluted dredged material

This material may be dumped at any approved site. Dredged material can be classified as unpolluted if: (i) It is composed of clean

[35] Fourth EPA report, p. 12 ff.
[36] Fourth EPA report, p. 15.
[37] 40 CFR 209.120.

sand, gravel, or other typical natural material. (ii) The water quality at the site from which the material is removed is of adequate quality for the type of biota normally found in such a site. Or (iii) a standard test to determine what effects dumping the material would have on the quality of water receiving it shows acceptable results. This standard test, the "elutriate test" simulates the release of potential pollutants when the material is dumped into the receiving waters. A sample of the material is mixed vigorously with water, allowed to settle, and the concentration of major constituents of the resulting solution is then measured. The concentration of no major constituent may be more than 1.5 times the concentration of the same constituent in the receiving water.[38]

It should be noted that the elutriate test is not without its critics. At the hearings, Kamlet stated: [39]

> The problem with the elutriate test is that it looks only at chemical changes in the water column and considers only readily released and water-soluble sediment constituents. It utterly fails to consider effects on bottom-dwelling organisms to whom material retained in sediment may continue to be toxic or bioaccumulative. It also fails to consider toxicants that may be released more slowly to the water column or those—for example petroleum hydrocarbons—which are not water soluble at all, but may nevertheless interact adversely with both the benthic biology and water quality. But its biggest failing is that it is no help to the decisionmaker in deciding whether or not to issue an ocean dumping permit.

Polluted dredged material

All dredge spoil not classified as "unpolluted" is classified as "polluted". Polluted material is typically found in heavily contaminated harbors and canals. Such material can contain very large concentrations of metals. For example, a sediment taken downstream of a metallurgical works was found to contain 3% chromium, comparable to a high grade ore.[40] As water pollution control becomes effective, dredge spoil should become less and less polluted. Before polluted material is dumped it must be shown that the dumping will produce no unacceptable adverse environmental impact. However, in practice, it appears that all such dumping is allowed one way or another since it has been stated that the Corps has never denied a permit for dumping.[41]

Dredged material permits

The Fourth EPA Report gives no information on the permit program of the Corps, nor does the previous year's report. This is a significant omission which needs to be remedied since dredged material represents the largest proportion of ocean dumping (80–90%) and occurs off all U.S. shores.[42] The Corps is now required by an amendment to the Marine Protection Research and Sanctuaries Act to report on its administration of the permit program.

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[38] It is anticipated that this procedure will be significantly modified and improved under revised regulations.
[39] Hearings, p. 27.
[40] Private communication to Committee staff.
[41] Hearings, p. 40.
[42] Hearings, p. 238.

CHAPTER V

HEARINGS

PURPOSE OF THE HEARINGS

The purpose of the hearings was to determine whether the regulations promulgated under the Act reflect the latest research results, and whether the research being carried out adequately supports the regulatory policy prescribed in the Act. The R. & D. activities of each agency involved under the Act, i.e., the Corps of Engineers, Coast Guard, NOAA, and EPA were examined. Another consideration was the particular mechanism by which research results are coupled into the regulatory process.

To accomplish these purposes the Subcommittee on the Environment and the Atmosphere held five days of oversight hearings in September, 1975.

ORGANIZATION OF THE HEARINGS

September 17, 1975:

Background

The first day of the hearings was designed to provide an introduction to the subject.

Witnesses

Dr. Michael Champ, assistant professor of biology, American University, Washington, D.C., and vice president of research, the Marine Science Consortium.

Kenneth Kamlet, counsel to the National Wildlife Federation.

September 18, 1975:

Witnesses on Industrial Chemical Wastes, testifying as a group

William R. Galloway, director of environmental affairs, Du Pont Chemical Co.

Dr. Clair Patterson, professor of chemistry, California Institute of Technology.

Dr. John B. Pearce, officer-in-charge, National Marine Fisheries Laboratory, Sandy Hook, N.J.

Witnesses on Sewage Sludge, testifying as a group

Thomas R. Glenn, director and chief engineer, Interstate Sanitation Commission.

Dr. Alan Mearns, director, biology division, Southern California Coastal Water Research Project.

Dr. Eliot Epstein, research soil scientist, USDA Agricultural Research Service, Beltsville, Md.

September 19, 1975:

Witnesses on Dredged Material, testifying as a group

Dr. Richard Peddicord, assistant research biologist, University of California, Berkeley, and Bodega Marine Laboratory.

Dr. Ferenc Szucs, professor of geochemistry, Slippery Rock College, and chairman, board of directors, Lake Erie Marine Science Center.

Dr. Grant Gross, adjunct professor, Department of Earth and Planetary Sciences, Johns Hopkins University, and director, Chesapeake Bay Institute.

Witness on Dumping in the Great Lakes

Dr. William Marks, chief, water development services division, Department of Natural Resources, Lansing, Mich.

September 24, 1975:

Witnesses on Research at EPA, NOAA, and the Corps of Engineers

Dr. Wilson K. Talley, Assistant Administrator for Research and Development, Environmental Protection Agency; accompanied by Dr. Eric Schneider, Acting Director, Environmental Research Laboratory, Narragansett, R.I.; and Dr. Donald Baumgartner, Chief, Coastal Pollution Branch, Environmental Research Laboratory, Corvallis, Oreg.

Dr. Donald B. Martineau, Deputy Associate Administrator for Marine Resources, National Oceanic and Atmospheric Administration; accompanied by Dr. P. Lawrence Swanson, Project Manager, MESA New York Bight project; and John S. Brookbank, Staff attorney, NOAA Office of General Counsel.

Dr. John Harrison, Chief, Environmental Effects Laboratory, U.S. Corps of Engineers, Waterways Experiment Station, Vicksburg, Miss.; accompanied by Dr. Robert M. Engler, Manager, Environmental Impacts and Criteria Development Project, Environmental Effects Laboratory; Waterways Experiment Station. Dr. John W. Kelley, Special Assistant, Program Development, USAE, Environmental Effects Laboratory, Waterways Experiment Station, Vicksburg, Miss.; and Jacobus Lankhorst, Assistant Chief Counsel for Civil Works Office, Chief of Engineers, Department of the Army.

September 26, 1975:

Witness on Coast Guard Programs

Rear Adm. Robert I. Price, Chief, Office of Marine Environment and Systems, U.S. Coast Guard.

Witness on Ocean Incineration

Donald D. Carruth, president, the American Eagle Foundation.

SUMMARY OF THE HEARINGS

Many of the points raised at the hearings have already been mentioned in other places in this report. This summary excerpts some of the testimony relevant to the focus of this report, but is not an analysis of the hearings.

Effects of Ocean Dumping

Given the focus of the hearings, the witnesses testified mainly on the effects of ocean dumping that need further research, rather than on examples of unambiguous adverse environmental impacts. For example, Dr. Pearce described research results that lead to further research rather than closing an area of concern (p. 96).

> It is now believed that certain contaminants, specifically heavy metals, vary in their effect on marine organisms depending upon their chemical state as well as their "binding" to particles of inorganic sediments or organic materials.

This finding suggests the need for more research in order to predict the effect of heavy metals on organisms, e.g., one must know the relative toxicity of a metal in various chemical states.

Dr. Champ observed (p. 14):

> One of the interesting things we found out in working with the acid waste water is that the waste itself is extremely caustic to the ship.

Surely an unambiguous adverse impact, indicating that short-term, local effects of ocean dumping might be acute.

On the other hand Mr. William Galloway, testifying for Du Pont, spoke rather unambiguously about the lack of ocean dumping effects (p. 78):

> In recent years, however, ocean disposal has been eliminated at Houston, Beaumont, Pontchartrain and Belle, but not because any harm was occurring. Indeed, all available evidence leads us to conclude that neither short- nor long-term damage ever occurred. The termination of these disposal practices has caused the investment of more than $11 million in treatment facilities and annual operating costs of over $8 million.

An appreciation of the disparity of testimony concerning dumping effects can be gained by comparing statements by Dr. Pearce and Dr. Harrison. Dr. Pearce stated that certain long-term effects are essentially unknown (p. 101):

> The long-term effects of dumping waste containing metals into the New York Bight can only be speculated upon at the present time.

On the other hand, Dr. Harrison, discussing the release of metals into the water column said (p. 247):

> Results have shown that water column effects of aquatic discharge are negligible in most cases. Release of silver, cadmium, and mercury into the water column did not exceed disposal water background concentrations for the variety of sediments tested.

Thus, it is not easy to ascertain exactly what is known, what is not known, and what research is needed without much deeper study of the problem.

Research has sometimes shown the way to mitigate particular effects. For example, an obvious possible effect of dumping dredge spoil is the burial of benthic (bottom dwelling) organisms, yet Dr. Harrison testified (p. 249):

> Other results have shown that representative benthic organisms have a significant ability to migrate upward through coverings of various depths of dredged material. Those organisms most severely impacted are sand dwellers that have a clay sediment deposited on them, and mud-dwelling organisms covered with a sandy dredged material. This indicates the desirability of choosing a disposal site with a substrate similar to the material to be discharged.

Thus, if sandy dredge spoil is dumped on a sandy bottom, the impact due to burial of the benthic organisms may be mitigated. Secondarily then, research results can possibly lead to guidelines for dumping practices which can reduce adverse impacts.

Regulation and Enforcement

While not central to the purpose of the hearings, there was some informative testimony concerning regulation. Mr. Kamlet was very critical of EPA and the Corps (p. 25):

> While there has been some progress and some harmful dumping has been phased out, the record, unfortunately, does not bear out EPA's claim of having taken "a strict, highly restrictive approach toward applying the criteria embodied in the act. * * *
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> But the record of the Corps of Engineers in controlling the ocean dumping of dredge spoil is even bleaker. Thus, between 1973 and 1974—in the space of a single year, the volume of ocean-dumped dredged material more than doubled, so that dredged material now accounts for more than 90 percent of all material ocean dumped, with ocean dumping being the method of disposal for a quarter of all dredge spoil. And despite the CEQ report's recommendation that "open dumping of polluted dredge spoils should be phased out as soon as alternatives can be employed" not one of the 159 permit applications (107 newly received, 52 carryovers) processed by the Corps of Engineers in fiscal 1974 was turned down.

Mr. Donald Carruth testified on the subject of ocean incineration. While this is not explicitly mentioned in the Act, EPA has administratively moved to assume responsibility. Thus, Mr. Carruth testified (p. 278):

> We strongly recommend that the act be amended to cover ocean incineration by U.S. Coast Guard approved incineration tankships. Not just any vessel should be allowed to do this type of job. There must be a specially equipped vessel—or vessels—with built-in equipment to do its own monitoring; and should be a very sophisticated, computerized type of vessel operation with the maximum of safety provisions for crew and vessel.

Admiral Price testified on the efforts of the Coast Guard at enforcement, which became their responsibility under the Act (p. 265):

> From April 1973 through June 1975, 593 toxic and 17,311 nontoxic dumps were reported to the Coast Guard; 1,273 ocean disposal surveillance missions were conducted; 37 violation notifications have been referred to EPA for penalty action, encompassing 155 apparent violations. The majority of these violations were failures by dumpers to properly notify the Coast Guard of their intended departure and estimated time of arrival at the prescribed site. The data available to us indicates that short dumping has been infrequent. Of the 155 various alleged violations noted, only 7 were charged with dumping outside of the designated site.

(It should be noted that in the Regulation Report, p. 62, the Coast Guard is reported to have responded to a question at a Senate hearing that the Coast Guard "does not have the necessary facilities or the expertise" to make chemical measurements of dumped materials to determine if the permit conditions relating to composition of the waste are being violated.)

Admiral Price also testified to the Coast Guard's relatively low priority regarding ocean dumping surveillance for the purpose of enforcement (p. 267):

> In practice, we must compete for resources with other longer standing and high-priority Coast Guard missions such as search and rescue, merchant marine and boating safety, and fisheries enforcement.

The Coast Guard presently has a comprehensive R&D program to improve their enforcement capability. They are developing a "black box" which can be used to record the dumper's position and thus indicate that dumping occurred at the approved site. However, it appears that they are making no attempt to develop the capability to check more than the most simple requirements of an EPA-issued dumping permit. This is not primarily a matter of research, however, because the ability to measure, for example, the composition of the wastes being dumped clearly exists. It is rather a matter of resources devoted to the enforcement effort.

Use of Research Results in Regulation

It has been mentioned above how research on migration of benthic organisms upward through various depths of dredged materials has indicated the desirability of choosing a disposal site with a substrate similar to the material to be discharged. This is a good example of how the incorporation of research results into disposal criteria can mitigate dumping effects.

Dumping of dredged material represents in effect a large, local increase above the normal "background" accumulation of sediment on the ocean bottom. The oceans contain many chemicals, salts and metals in background concentrations—marine life is adapted to these background concentrations and as pointed out by Mr. Bascom (p. 115) the organisms require certain trace amounts of some of these metals, etc., for their well-being, while higher levels might well be toxic. Mr. Bascom (in his statement for the record, submitted by Dr. Mearns) went on to say:

> Fortunately for most animals there is a substantial spread between the levels of possible pollutants they require and the level of harm. Thus it is possible for man to add slightly to the background levels of pollutants in the sea without causing damage.
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> The question then becomes: How much should we allow the background to rise? and at what rate? It is possible for scientists to get reasonably reliable answers to these questions and for legislators to make laws that give a large margin of safety to cover possible errors. This would result in our taking actions that fit the real world. We should be careful but not over-cautious.

Dr. Pearce (p. 99) established a more cautious tone in his remarks which discussed the problem of such manmade chemicals as chlorinated hydrocarbons, for which there is no natural background.

> Thus, while some scientists regard the dispersal or "mixing zone" approach to heavy metals and other conservative, long-lived contaminants, as representing adequate methods of dispersal of domestic and industrial wastes, many other scientists are concerned about the long range effects of such dispersal techniques. It is now known that DDT and certain other contaminants are widely spread throughout the entire marine environment.
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> Since scientists are presently uncertain of the eventual effects of even very small amounts of certain contaminants, wise management of the marine environment requires us to be particularly cautious in establishing the limits for the amounts and types of toxic contaminants to be dispersed into marine waters.

While the comments of Mr. Bascom and Dr. Pearce imply a need for additional research before regulatory decisions can be made that are based on good scientific information, Mr. Kamlet emphasized that the problem is with us now and must be dealt with (p. 29):

> Action on the pollution problem cannot be put aside while scientists unravel the complexities of ecosystem integration. We must take whatever steps are possible with the knowledge currently at our disposal.

It is just this necessity to act on the basis of available information that demands some involvement of scientific expertise in agency policy-making. Since research results are not complete and unambiguous, best judgment decisions must be made and this requires participation by scientists familiar with research trends. Mr. Kamlet commented on the involvement of EPA scientists in regulatory decision making within EPA (p. 58):

> Our impression, based on close contact with the EPA ocean dumping program over the past two-and-half years, is that marine scientists and other experts are seldom adequately involved in important ocean dumping policy decisions and regulatory actions.

Dr. Gross commented on the same matter from a different point of view. He contested that EPA technical information is often effectively unavailable to policymakers because it is not translated into language understandable to the policymakers (p. 157). Dr. Gross went on to offer a specific plan to facilitate the translation of research results into regulatory action (p. 170):

> EPA could well model its research support activities after the Office of Naval Research to improve the translation of research results into operational use. It calls for assigning individuals with specific responsibilities for research direction and coordination, and further charging the EPA staff members with the translation for EPA needs. It is unrealistic to expect good research scientists to be able to put their results in the forms needed for agency operations.

Dr. Gross envisions a corps of "middlemen" who could understand both the needs of the regulators and the research results of the technicians and therefore provide a two-way communication service, thus indirectly involving researchers in regulatory actions.

Dr. Harrison of the Corps of Engineers gave a good description of the kinds of information needed to adequately regulate the dumping of dredged material. A large part of the research needed is that which can lead to the development of tests for determining the effects of dumping the material (p. 247 ff).

> Research results to date show that dredged material is a complex solid and liquid composite of naturally occurring soil materials—sometimes contaminated with various domestic, industrial, and agricultural wastes including urban runoff. However, unlike many of these substances, the presence of a chemical contaminant in dredged material does not necessarily indicate the pollution status of the material. This is because the chemical form and location of a contaminant within the sediment matrix, not its mere existence, dictate the effects of disposal on water quality and aquatic organisms.
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> At present, there is no bioassay procedure suitable for the solid-phase portion of dredged material. However, we are currently developing such a procedure under contract. There are no data at this time on the results of this research; however, it is anticipated that such a bioassay procedure will be developed within the next year.
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> * * * * * * *
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> A variety of tests and evaluative approaches, which can be used singularly or in combination, are included in these guidelines. This is because both the EPA and the corps realize that no single test or approach can be applied in all cases. In order to assess the effects on water quality and aquatic organisms, the guidelines provide for the use of an elutriate test and/or bioassays. The evaluation of the significance of chemical-biological interactive effects on benthic organisms may be determined by the use of benthic bioassays. The guidelines also provide for comparing the dredging and proposed disposal sites through the use of total sediment analysis, analysis of biological community structure, and the use of biological indicator species.

Although regulation of the dumping of dredged material demands further research, an even greater need for research exists related to the regulation of dumping other wastes. Dr. Harrison emphasized this by noting that the criteria used to regulate the disposal of dredged material cannot be used for domestic and industrial wastes (p. 247). This was further emphasized by Dr. Swanson, who pointed out the difficulty of regulating sludge dumping based on measurement of dumping effects at the site. He explained that because the sludge does not sink "it does not physically stay in the area, then it is far more difficult to manage as far as regulation is concerned." (p. 228.)

Agency Research Programs

The hearings did not bring out detailed descriptions of the agency research programs, but useful information was presented. For example, Dr. Talley described the general philosophy and objectives of the EPA research programs (p. 188):

> I would like to begin by stating that all research performed by EPA is, by necessity, directed toward providing the Agency with a scientific foundation to carry out its congressionally mandated regulatory and enforcement role to protect and enhance the environment. Consequently, the research performed in relation to ocean dumping is strongly mission-oriented to provide the ocean disposal permit program with the most effective scientific data base to implement the program. Ocean dumping research has three objectives:
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> (1) The development of new information for revisions of the ocean dumping criteria;
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> (2) The development of methodologies to predict the ecosystem impact of proposed dumping operations; and
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> (3) The development of methodologies to assess and monitor ecosystem damage resulting from improper disposal operations.

He went on to provide the following budget figures (p. 192):

R. & D. OCEAN DISPOSAL RESEARCH BUDGET

[In thousands of dollars]

Performing laboratory	Fiscal year—			
	1973	1974	1975	1976[1]
Narragansett Environmental Research Laboratory	0	$347	$427	$454
Gulf Breeze Environmental Research Laboratory	0	3	22	41
Corvallis Environmental Research Laboratory	$476	434	728	773
Washington, D.C., Headquarters	0	0	25	25
Totals	476	784	1,202	1,293

[1] Projected Presidential Budget.

The EPA program is described more fully in the Fourth Annual Report,[5] and in the Third Annual NOAA report on ocean dumping research.[43]

Dr. Martineau described the focus of the NOAA program (p. 214):

> Both the concentration of nondredge spoil dumping in the New York-New Jersey metropolitan region and the major research efforts of the Corps of Engineers on dredge spoil disposal already underway in 1973 influenced NOAA's planning for implementation of title II of the act. The emphasis of the NOAA

[43] Report to the Congress on Ocean Dumping Research; January through December 1975. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. U.S. GPO, Washington, D.C., June, 1976. Hereafter referred to as the Third NOAA report.

program has consequently focused on nondredge spoil dumping, and the initial effort has been conducted in that coastal region where the problem was and still remains most acute—the New York Bight.

The NOAA research program is described more fully in their third annual report.[43]

Dr. Martineau expressed the expectation (p. 215) that results of the NOAA study of the New York Bight would be applicable to other coastal areas. He also mentioned an interagency agreement between EPA and NOAA in which NOAA would conduct baseline surveys for EPA and interagency cooperation betwen NOAA and the Corps with respect to "studying the impacts of dredged material disposal in the New England area" (p. 216).

Mr. Kamlet claimed that ocean dumping regulation has been given a low priority in EPA and the Corps and this would seem to extend to ocean dumping research as well. He said (p. 41):

Despite their clear purpose of strict regulation, the Federal ocean disposal statutes are relatively non-specific and general about how the implementing agencies are to accomplish this objective. Because so much is left to agency interpretation and initiative, the philosophical approaches of these agencies to meeting the statutory goals can decisively influence the vigor, effectiveness, and adequacy of the regulatory effort.

Unfortunately, close regulation of ocean disposal activities has, by and large, commanded a very low agency priority.

The results of a low priority approach were mentioned by Dr. Gross (p. 156):

First, in my opinion, existing programs have limited funding, and generally are restricted to specific agency-related problems such as bioassay techniques or to problem areas such as the New York Bight. I do not see research programs underway that will provide the answers needed about long-term effects of ocean disposal. Instead they are dealing with well known problem areas and all too often responding on a crisis basis.

It should be pointed out that contrary to Dr. Gross' statement Dr. Talley claimed that EPA research includes work on the effects of long-term exposure, but he then described the program as if there were no long-term effects (p. 189):

EPA's marine research relating to ocean dumping criteria attempts to determine the ecosystem effects due both to short-term and long-term exposures of pollutants to marine life. Ocean dumping operations are usually thought of as producing short-term exposure of pollutants to marine organisms. The turbulent mixing in the wake of a moving barge plus the natural diffusion of materials in large volumes of receiving water does provide for rapid dilution. The criteria do consider the dilution phenomena as providing adequate protection for those materials which are known not to accumulate in marine species, which are readily biodegradable, and whose toxicity is such that following a short-term dilution will cause no ecosystem damage.

Dr. Gross describing the need for longer term commitments to research and the problems that arise when only short-term projects are carried out (p. 157–8) stated:

Second, present research programs are too small and have too short a project life to support the scientific and technical infrastructure necessary to make long-term advances in the field of ocean disposal. Within the 5 years or less that the existing programs are projected to last, it is not possible to recruit scientists or to train students to cope with the existing situation—or more importantly—to devise new techniques and approaches to old problems. Under these circum-

stances, regulatory agencies are restricted of necessity to using off-the-shelf technology. In many cases the answers developed are ineffective, not cost effective, and cannot cope with long-term problems associated with ocean disposal.

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Mr. Chairman, in short, we need a longer range view of ocean disposal problems from the Federal agencies involved, combined with more, long-term research support. Better utilization of the available qualified oceanographers can contribute much to more effective control of ocean dumping problems. I think that none of the agencies have fully accepted this responsibility and have given us a research program which, I believe, to be appropriate considering the magnitude of the problem.

It should be recognized that Dr. Gross discusses two different aspects of research, both referred to as "long-term" but nevertheless being different, and both lacking in priority and emphasis. He first describes the lack of research efforts on long-term (i.e., chronic) effects of dumping. Second, he decries the lack of long-term research programs—i.e., not just one-year/one-task contracts but continuing programs which will allow for the training of staff and the accumulation of experience and equipment. An example of this deficiency in long-term support was cited by Dr. Peddicord, who described a period of several years during which support for his ocean dumping research project was both accepted and dropped by NOAA. According to Dr. Peddicord, during this period NOAA would not make commitments to the research nor would NOAA allow the Corps to take over and fund the project (pp. 146–8).

Dr. Gross described a problem that arises with the funding of "basic" research which would of course affect much long-term research. The Office of Management and Budget seems to adhere to the point of view that one agency should be lead agency for a given mission and should fund all research in support of that mission. Further OMB feels the research should be "applied" to the mission, and only the National Science Foundation (NSF) should fund "basic" research. Dr. Gross said (p. 156):

I might also point out something else as a result of my experience at the NSF, that in a situation such as this where an agency has been given responsibility but fails to follow up, other agencies may actually withdraw funds from research support in that area. For example, the "kiss of death" can be to say this is a pollution problem and it usually does not receive support as basic science. So an agency failing to provide the appropriate response to the problem area can actually stifle research in an area.

Dr. Gross also commented on the need for agencies to get their research results out to other users—especially State and local officials. He stated that (p. 157):

I think it is important that the Federal agencies should play more of a leadership role in bringing this research which they support to the attention of the State and local officials involved. It is a sobering thought to realize that even if we now had the solutions to the problems that it would take years and possibly decades before new facilities could be built and new procedures implemented.

Thus any effort to reduce delay in the knowledge-transfer process will likely pay off handsomely in protecting the public interest. And I might say that they would be at relatively low cost.

Finally, Dr. Champ commented on the research being conducted by dumpers. This could be a very useful adjunct to the agency research

program if the research could somehow be carried out in such a way as to remove Dr. Champ's objection of "the fox guarding the chicken house" (p. 17):

> In the policy area of research and development, there is also a practice which I recommend be discontinued. EPA currently may require that an ocean dumper, for his interim permit, conduct special studies. The findings from these studies are used by EPA in reviewing the next year's permit application. This is an old classic example of the "fox guarding the chicken house." The company should be required to pay an environmental assessment fee from which Federal agencies would fund baseline studies or special studies. This would prevent vested interests from directing, designing or interpreting the findings of the study.

Research Needs

Several research needs were identified in testimony at the hearings. Some of these have been mentioned previously in connection with other matters, e.g., the need for tests to measure dumping effects for regulatory purposes. With some repetition, the most important needs are listed here in a very approximate order of emphasis, based on the testimony.

Perhaps the most pressing need is for improved bioassays—these are tests in which, under controlled laboratory conditions, sensitive marine organisms are exposed to the material to be dumped. Dr. Peddicord explained the importance of such (p. 147):

> At present, the criteria distinguishing polluted and nonpolluted dredged materials are incomplete. The criteria are chemical, yet present knowledge does not permit estimation of biological impact based only on chemical analysis. This is particularly true of mixtures as complex and variable as dredged material. The present sampling and analysis techniques used to determine the composition of dredged material seem adequate . . . but toxicity can be determined only in a biological context. Chemical analyses must be complemented with bioassays in order to know the potential impact of a particular dredged material on aquatic organisms. Biological effects of complex mixtures of toxicants are insufficiently understood to estimate ecological impact from knowledge of the chemical composition of dredged material. Bioassays are needed for complete evaluation of the potential environmental impact of ocean disposal of dredged material.

(See also Talley, p. 193; Harrison, p. 249, p. 261; Kamlet, p. 51.)

The second area of need is actually a group of related or dependent needs. This second area involves understanding the fate of a pollutant injected into a natural system: We need to understand its metabolic pathway after organisms ingest it, and its physico-chemical pathway through the ecosystem. This would include such diverse approaches as bioassay studies of organisms exposed to various levels of contaminants, studies of pollutant transport and diffusion, and studies on the effects of heavy metals at the cellular level (Champ, p. 17; Patterson, p. 105; Kamlet, p. 51; Patterson, p. 92; Mearns, p. 119).

There was testimony concerning the need for several different kinds of models to predict the transport and distribution of dumped material and to predict the rates of mixing/dilution of the dumped material (Champ, p. 17; Kamlet, p. 51; Peddicord, p. 147; Talley, p. 193; Mearns, p. 122).

There was testimony supporting the need to study ecological effects of dumping and related effects. It has been said that the lesson of ecology is that everything is connected to everything else. Dr. Mearns

echoed this in describing our lack of understanding of ecological processes (p. 119):

> Another constraint is our modest understanding of ecological processes in the sea and our inability to really predict man-induced and natural changes. For example, the often-cited food chain in which small animals are eaten by increasingly larger ones is only one part of the food web in coastal waters. Eggs of a marine predator—I might cite a halibut or a barracuda—have a good chance of being eaten by its own prey or even by lower forms of benthic and planktonic life. This may well be a major process in the sea and suggests that an "unstructured food web" which has no analogy on land or in laboratory experiments.

(See also Mearns, p. 122; Talley, p. 193.)

There were related suggestions that more monitoring and surveillance is needed (Mearns, p. 122; Kamlet, p. 51). Along this line Dr. Talley (p. 193), testified that there is a need to develop biological indices for measuring the health of an ecosystem. Such indices could be determined through "baseline" studies and monitoring over time to detect trends in environmental health.

The results of research of this type would make possible the development of rational criteria for selecting disposal sites (Kamlet, p. 51), for determining long-term chronic effects (Pearce, p. 99), and short-term effects (Champ, p. 17).

Dr. Pearce testified on the lack of long-term exposure experiments:

> Unfortunately, these experiments and others are often conducted over relatively short time spans, i.e., 48 to 96 hours. Thus the long range, chronic effects of various industrial wastes remain to a great extent unknown. Also, the total effect of numerous industrial wastes cannot be determined using such techniques. Embayments such as Raritan Bay and Long Island Sound function as "mixing zones" for the various domestic and industrial wastes discharged into them. While the wastes may be greatly diluted by their discharge into these large volume reservoirs their ultimate effects remain unknown. However, one thing that is certain is that continued discharge of domestic and industrial wastes into embayments such as Raritan Bay has resulted in the complete disappearance of many ecologically important species. For instance, certain species of amphipods have disappeared completely during the last two decades.

Since so much sewage sludge is ocean-dumped there is a need to understand the effects on the ocean of sludge generated by different sewage treatments (Mearns, p. 119; Talley, p. 193). This consideration could ultimately involve the possibility of alternate disposal methods for sludge because, if properly treated, sludge might be a useful material. For example, one drawback to the use of sewage sludge as a soil conditioner is the presence of heavy metals in the sludge. Thus, a sewage treatment removing heavy metals might actually create a demand for sludge as a soil conditioner, and eventually eliminate the need for dumping.

Finally, Dr. Gross (p. 170) estimated that an additional $30 million per year could be effectively utilized to support research on oceanic waste disposal problems.

Research on Alternatives to Ocean Dumping

Title II of the Act assigns the responsibility for research on methods to minimize or end dumping to NOAA, but NOAA has consciously avoided assuming this responsibility (Dr. Martineau, p. 217):

> The Department also has been assigned responsibility under the act to promote means of minimizing or ending ocean dumping. Such reduction of ocean dumping involves the development of alternative methods such as incineration, land dis-

osal, and waste recycling. The principal Federal scientific and technical expertise for development of these alternatives is located within the Environmental Protection Agency and the Corps of Engineers.

Both agencies have active programs underway in this area.

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The National Oceanic and Atmospheric Administration has placed first priority on implementing title II of the act on studies to determine the environmental effects of ocean dumping. For the Department of Commerce to build a capability to develop alternative waste disposal methods to ocean dumping would involve duplication of existing scientific and technical resources and programs.

Dr. Martineau did not mention the work in the Department of Agriculture on the utilization of sewage sludge. It is true that the Corps, as part of its Dredged Material Research Program, is working on such alternatives to dumping as the use of dredge spoil to produce artificial islands and marshes thus improving habitat for valuable species. In addition, EPA has programs on the recovery of resources from solid waste and improved wastewater treatment, both of which could possibly lead to the reduction in the amount of material needing to be dumped.

Dr. Epstein discussed his work with sewage sludge (pp. 123–130):

. . . want to present to you a complete different view on ocean dumping of sewage sludge. Sewage sludge is primarily organic matter containing various quantities of impurities. As such it should be treated as a potential resource and recycled into the environment in the most useful way.

* * * * * * *

The best potential use of sewage sludge or its products would be for improvement of marginal or disturbed lands. These would include urban areas, construction sites, cemeteries, recreational areas, roadbanks, gravel pits, and strip mines. Soils in these areas are usually low in organic matter, low in nutrients, and have poor soil structure. The incorporation of sewage sludge will also stabilize soils reducing runnoff and erosion.

* * * * * * *

Some of the research areas which I believe need stimulation are:

1. Develop systems which reuse, and recycle sewage sludge.
2. Intensify research on pathogen survival, trace elements and environmental pollution. This is necessary in order to formulate proper guidelines.
3. Increase research on recovery of trace elements. Emphasis should be placed on recovery at the source rather than cleanup at the waste water treatment plant. Consideration should be given to assisting industries in effluent cleanup and resource recovery.

Mr. Kamlet touched on yet another approach to dredged material—one which has not been actively pursued (p. 31):

. . . probably the best solution to the problem of dredge disposal is to cut down on the amount of dredging which has been done and that could be done by going after the situations which cause sediment to accumulate and which make dredging necessary in the first place. Source reduction, as you might call it, is an approach which is looked on favorably by many scientists.

Finally, ocean incineration must be thought of as a possible alternative to conventional dumping. EPA has issued research permits for experimental trials of ocean incineration. The experience has been successful. The material burned in these trials probably could not have been dumped under provisions of the Act, so we can actually view ocean incineration as an alternative to disposal of these materials on land. It is possible that some materials now being dumped in the ocean could be incinerated at sea.

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